USGS

Sound Waves

Coastal and Marine Research News from Across the USGS

http://soundwaves.usgs.gov/

Fieldwork

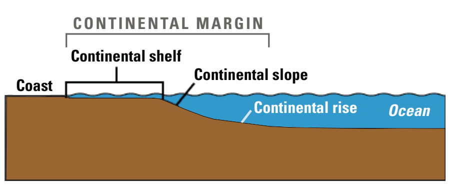
High-Resolution Multibeam Mapping of Mid-Atlantic Canyons to Assess Tsunami Hazards

By Jason Chaytor and Daniel Brothers

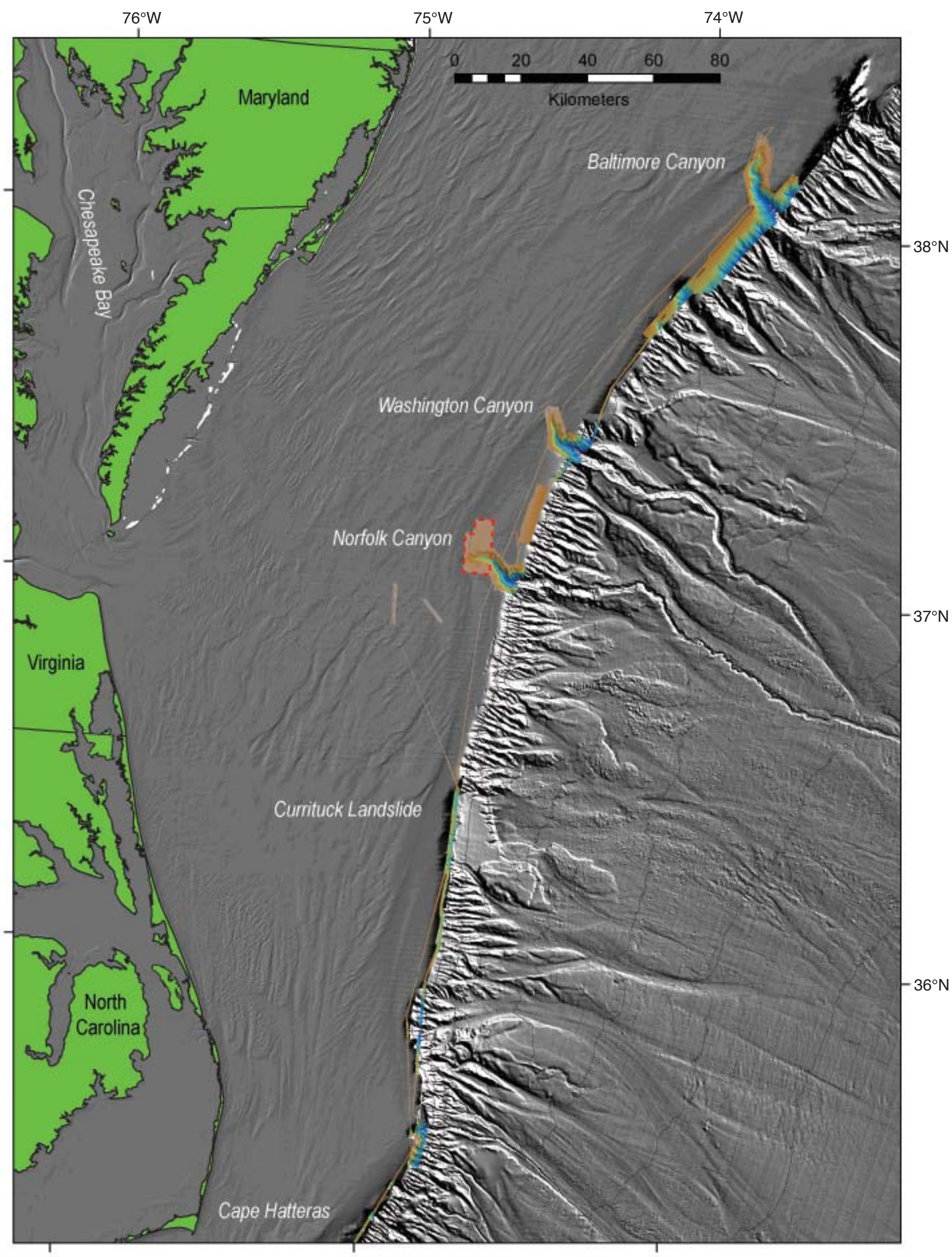
For the past 5 years, U.S. Geological Survey (USGS) scientists at the Woods Hole Coastal and Marine Science Center in Woods Hole, Massachusetts, have been studying submarine canyons and landslides to assess the potential for landslide-generated tsunamis along the U.S. east coast. This study was requested and funded by the U.S. Nuclear Regulatory Commission (NRC), which is concerned about the potential impact of tsunamis on new and existing nuclear power plants. Recent devastating tsunamis in Samoa (2009), Chile (2010), and Japan (2011) offer sober reminders of the importance of accurately identifying and characterizing the natural events, or "sources," that can generate tsunamis.

In a study funded by the NRC in 2009, the USGS identified submarine landslides along the submerged continental margin as the primary potential source of dangerous tsunamis to the U.S. east coast. Such landslides fall into two categories: (1) those that originate in submarine canyons and (2) those that originate on the continental slope and rise between submarine canyons ("open slope" landslides). Because submarine landslides and canyons are closely related, the USGS scientists studying these phenomena expect their data to shed light on such fundamental questions as "How do submarine canyons form?" as well as to

(Canyons continued on page 2)



Idealized diagram of a continental margin, showing the shelf, slope, and rise.



Multibeam bathymetric data collected during the June 2011 Nancy Foster *cruise (except for area around upper Norfolk Canyon, surrounded by dashed red line, where data are courtesy of* ***Rod Mather****, University of Rhode Island). The gray shaded-relief data were compiled from existing bathymetric datasets produced by the USGS Woods Hole Coastal and Marine Science Center.*

Sound Waves

Editor
Helen Gibbons
Santa Cruz, California
Telephone: (650) 329-5042
E-mail: hgibbons@usgs.gov
Fax: (831) 427-4709

Print Layout Editors
Susan Mayfield, Sara Boore
Menlo Park, California
Telephone: (650) 329-5066
E-mail: smayfiel@usgs.gov; sboore@yahoo.com
Fax: (650) 329-5051

Web Layout Editor
Jolene Gittens
St. Petersburg, Florida
Telephone: (727) 803-8747 Ext. 3038
E-mail: jgittens@usgs.gov
Fax: (727) 803-2032

SOUND WAVES (WITH ADDITIONAL LINKS) IS AVAILABLE ONLINE AT URL
http://soundwaves.usgs.gov/

Contents

Fieldwork 1
Research 9
Staff and Center News 11
Publications 12

Submission Guidelines

Deadline: The deadline for news items and publication lists for the December issue of *Sound Waves* is Friday, October 14.
Publications: When new publications or products are released, please notify the editor with a full reference and a bulleted summary or description.
Images: Please submit all images at publication size (column, 2-column, or page width). Resolution of 200 to 300 dpi (dots per inch) is best. Adobe Illustrator© files or EPS files work well with vector files (such as graphs or diagrams). TIFF and JPEG files work well with raster files (photographs or rasterized vector files).

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

U.S. Geological Survey
Earth Science Information Sources:

Need to find natural-science data or information? Visit the USGS Frequently Asked Questions (FAQ's) at URL **http://www.usgs.gov/faq/**

Can't find the answer to your question on the Web? Call 1-888-ASK-USGS

Want to e-mail your question to the USGS? Send it to this address: ask@usgs.gov

Fieldwork, continued

(Canyons continued from page 1)

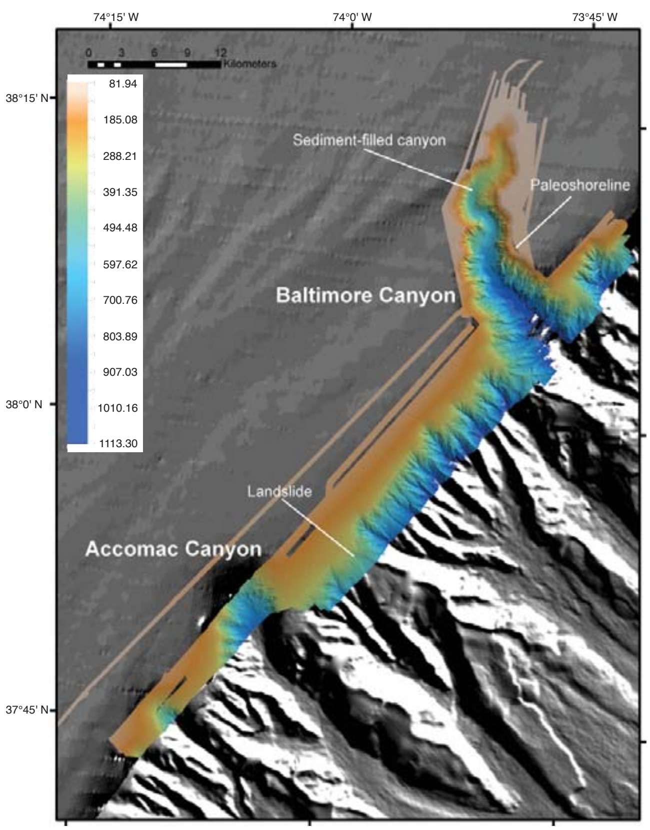
provide vital information for assessing the risk posed by landslide-induced tsunamis.

Critical to the USGS evaluation of submarine landslides and canyons has been the availability of high-resolution bathymetric (seafloor depth) data along the shelf edge, slope, and rise of the Atlantic continental margin. Many of these data were collected in support of the establishment of the U.S. Extended Continental Shelf (where the United States can exercise sovereign rights over seabed and subseabed resources; see **http://continentalshelf.gov/**). Additional data were collected by the USGS in 2009 on the upper slope between Cape Hatteras and Georges Bank to support submarine-landslide studies (**http://soundwaves.usgs.gov/2009/08/fieldwork.html**).

Although the U.S. Atlantic continental margin is now one of the best-mapped margins in the world, significant gaps still remain along the upper slope and shelf, where evidence of the margin's dynamic evolution is recorded. The USGS Woods Hole science center recently took the opportunity to fill some of these gaps by collaborating with a group of scientists on the multiyear Deep-Water Mid-Atlantic Canyons Project, a systematic exploration of submarine canyons off the U.S. mid-Atlantic coast. This effort, which is being funded by the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), the USGS, and the National Oceanic and Atmospheric Administration (NOAA) office of Ocean Exploration and Research (OER), involves multiple investigators from academic and governmental institutions. Project scientists are studying the ecology, geology, and oceanography of the canyons, focusing on sensitive deep-water corals and cold-seep communities. (An associated study on "Microbial Ecology of Deep-Water Mid-Atlantic Canyons" is described in this issue; see **http://soundwaves.usgs.gov/2011/10/pubs2.html**). Another important aspect of the project is the identification and investigation of historically significant artifacts in the study area, particularly shipwrecks.

The first field effort of this project was a multibeam bathymetric mapping cruise conducted aboard the NOAA Ship *Nancy Foster* from June 4 to June 16, 2011. The cruise was headed by **Steve Ross** (University of North Carolina Wilmington) and **Sandra Brooke** (Marine Conservation Institute and Oregon Institute of Marine Biology) and included **Jason Chaytor** and **Daniel Brothers** (USGS Woods Hole Coastal and Marine Science Center), **Rod Mather** (University of Rhode Island), **Caitlin Casar** (intern of **Amanda Demopoulos** at the USGS Southeast Ecological Science Center), and students **Veronica Holton** (College of Charleston) and **Megan Prescott** (University of Washington). The sites of

(Canyons continued on page 3)



High-resolution multibeam bathymetry collected in and between Baltimore and Accomac Canyons during the June 2011 cruise. Color key at left shows depths (in meters).

(Canyons continued from page 2)

primary interest were Baltimore, Washington, and Norfolk Canyons and selected regions of the continental shelf between the canyons.

Using a combination of hull-mounted Kongsberg-Simrad EM1002 and Reson 7125 multibeam echosounders installed on the *Nancy Foster*, the science team mapped canyons and shelf regions at high resolution (horizontal resolutions of 5 m in shallower water and 10 m in deeper water, vertical resolution of approximately 1 m), providing an unprecedented view of the study sites' morphology. Both bathymetric and backscatter data (related to seafloor texture and composition) were collected along a total of 2,520 km of survey trackline (exceeding 1,000 km^2 of seafloor coverage) extending from south of Cape Hatteras to Baltimore Canyon.

*The Deep-Water Mid-Atlantic Canyons Project mapping science party (left to right): **Steve Ross, Veronica Holton, Sandra Brooke, Megan Prescott, Caitlin Casar, Rod Mather, Danny Brothers** (kneeling), and **Jason Chaytor**. Photograph courtesy of **Steve Ross**.*

Preliminary analysis of these new data reveal the presence of sharp, stepped erosional escarpments rimming the upper slope around each of the mapped canyons, which may be submerged paleoshorelines cut during periods of lower sea level. Furthermore, each of the canyons displays markedly different sedimentary processes, from canyon-filling sedimentation to formation of sediment waves, maintenance of channel thalwegs, and incision of canyon walls by gullies. Several submarine landslides, some previously unknown, were also partly mapped. In some places this mapping provided the data needed to attain complete coverage of the landslides, allowing them to be fully evaluated as part of the tsunami-source-analysis project. Future plans call for collecting sediment cores that will be used to date large landslides, a critical step in determining landslide "recurrence intervals"—that is, determining how often large landslides, and associated tsunamis, are likely to occur.

To learn more about the June research cruise, visit NOAA's Ocean Explorer Web site at **http://oceanexplorer.noaa.gov/explorations/11midatlantic/welcome.html**. Informative background essays and logs from sea are posted on the Web site hosted by the North Carolina Museum of Natural Sciences at **http://deepwatercanyons.wordpress.com/**. ☸

USGS Scientists Develop System for Simultaneous Measurements of Topography and Bathymetry in Coastal Environments

By Jim Flocks and Athena Clark

Researchers with the U.S. Geological Survey (USGS) Alabama Water Science Center (**http://al.water.usgs.gov/**) and the USGS St. Petersburg Coastal and Marine Science Center (**http://coastal.er.usgs.gov/**) met in Biloxi, Mississippi, July 11-15, 2011, to assemble and test a boat-mounted system that simultaneously measures topography (onshore elevations) and bathymetry (seafloor depths) in nearshore environments. The USGS Ecosystems Program funded the project.

The components of the system are a light-detection-and-ranging (lidar) instrument for measuring onshore elevations and an interferometric sonar for measuring seafloor depths. The lidar, an Optech ILRIS HD-ER-MC, is fixed to the top of a shallow-draft vessel to scan the shoreline with a laser beam in a horizontal direction. This instrument is capable of producing three-dimensional point-cloud images of the terrestrial environment, as demonstrated in a recent analysis of historic live oaks in Auburn, Alabama (see **http://al.water.usgs.gov/tlidar/toomersoak.html**). The interferometric sonar, a SEASwath 468H, provides not only high-resolution seafloor bathymetry (depths) but also backscatter (a proxy for seafloor texture; for example, see **http://soundwaves.usgs.gov/2009/03/**). An onboard Global Positioning System (GPS) receiver (an Ashtech differential GPS system) uses satellite signals to determine the vessel's position, and a motion sensor (Applanix POS MV L1/L2) provides highly accurate data about the vessel's attitude, heading, heave, position, and velocity.

Both the lidar and the sonar operate on similar principles: each instrument emits

(Topography and Bathymetry continued on page 4)

The lidar system (yellow box) and motion sensor (orange box) are mounted above the vessel, and the sonar system between the outboard motors. When deployed, the sonar system rotates down and slides on rails between the catamaran keels until it is in a vertical line with the lidar system and the motion sensor.

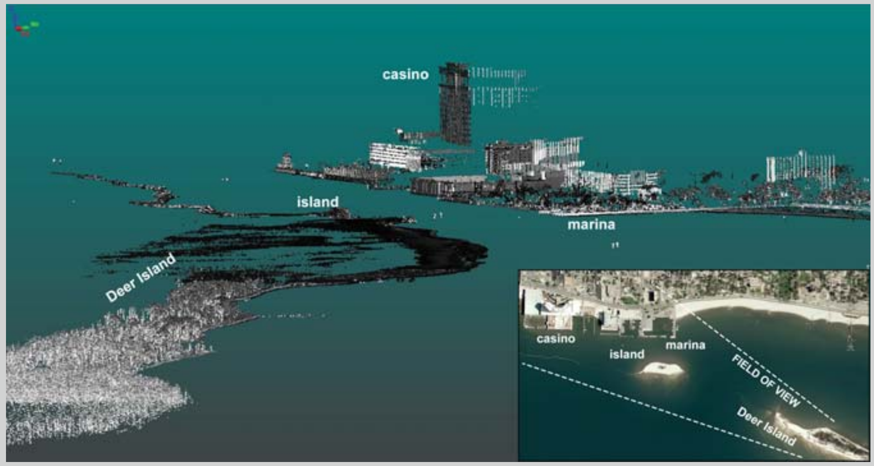
(Topography and Bathymetry continued from page 3)

energy—light from the lidar and sound from the sonar—that reflects off a point, or “target,” and returns to a receiver on the instrument. Knowing the direction the energy travels, its speed, and the time it takes to travel to the target and back allows calculation of the target’s position relative to the instrument. To get the desired information—the target’s position in three-dimensional space (for example, its elevation, latitude, and longitude)—the instrument’s position in three-dimensional space must be determined. Furthermore, to integrate the topographic and bathymetric datasets, the relative positions of the lidar, sonar, and motion sensor also must be precisely determined. To facilitate these determinations, the instruments were mounted in a vertical line, and their positions relative to each other and to the vessel’s GPS receiver were measured by using a “total station”—a tripod-mounted assembly of electronic instruments used in surveying.

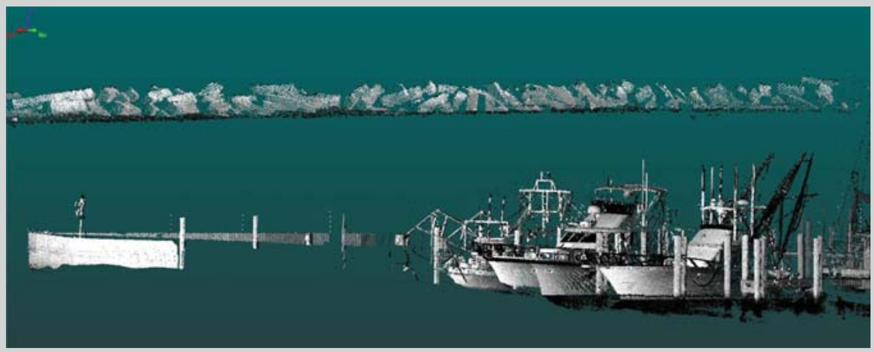
During a marine survey, determination of the position of the vessel must accommodate motion in any direction. The GPS tracks vertical and horizontal movement, while the motion sensor keeps track of pitch and roll; and the inline position of the instruments facilitates instantaneous calculations because it reduces the angular movement of each instrument relative to the others. The fixed-position information from the total-station data and the motion data from the onboard sensors allow calculation of the lidar’s and sonar’s positions while mapping is underway. Through calculating the position of the vessel and the calibrated speed and trajectory of light and sound, the positions of targets on land and in the water can be determined simultaneously.

Before the survey, the lidar was calibrated by measuring static (unmoving) targets of known distance, again using a total station. During the survey, the sonar was calibrated to the acoustic properties of the water by repeatedly measuring sound velocity, which is affected by changes in salinity, turbidity, and temperature. Finally, an Ashtech GPS base station deployed over a nearby bench mark provided data to correct for atmospheric distortion of the GPS signals. The data streams from the lidar and the sonar were acquired and processed by using Applanix POSPac MMS and Hypack HySweep software.

(Topography and Bathymetry continued on page 5)



*Oblique lidar scan of Deer Island and buildings in the neighboring city of Biloxi, Mississippi. Inset shows aerial view. Lidar example by **Dustin Kimbrow**; aerial orthoimagery from the USGS, May 2006 (before restoration).*



*Lidar scan of boats in the marina (see image above for location) and adjacent Deer Island. Lidar example by **Dustin Kimbrow**.*

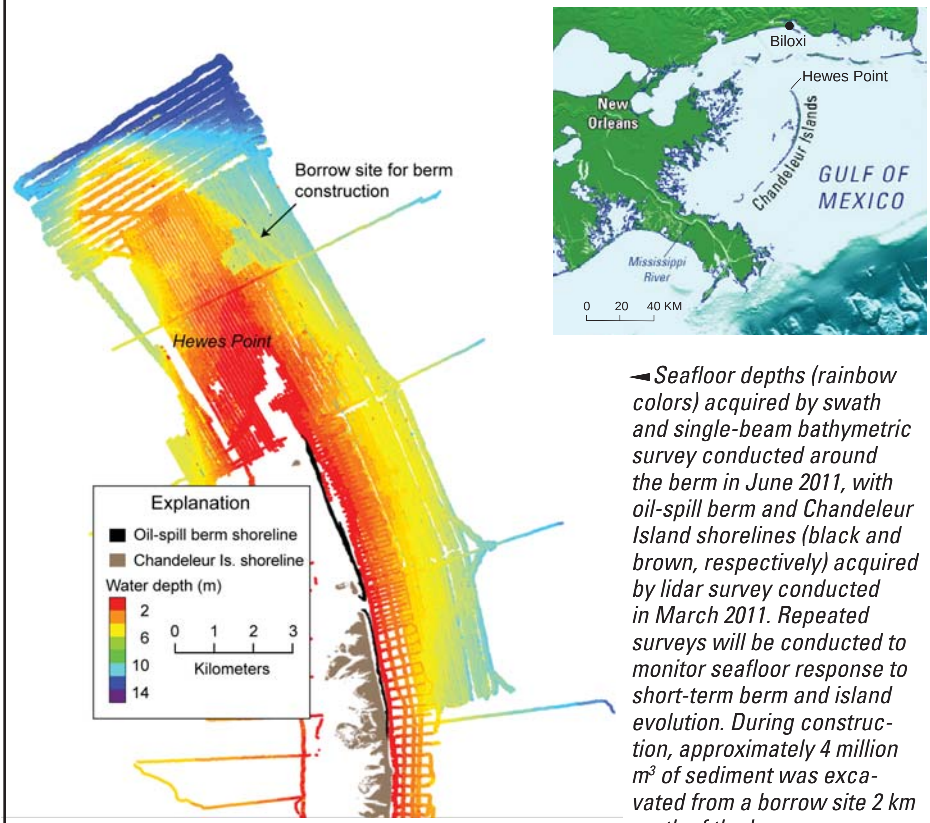
*Oblique perspective of the elevation point cloud acquired by the lidar system of the oil-spill mitigation berm and northernmost Chandeleur Islands. The aerial photograph (above right) was taken in January 2011 at about the same orientation, while the berm was still under construction. Lidar example by **Dustin Kimbrow**; aerial photograph courtesy of the U.S. Fish and Wildlife Service.*

(Topography and Bathymetry continued from page 4)

On hand for the experiment were **Athena Clark**, **Dustin Kimbrow**, and **Kathryn Lee** from the Alabama Water Science Center, and **Dana Wiese**, **BJ Reynolds**, **Kyle Kelso**, and **Jim Flocks** from the St. Petersburg Coastal and Marine Science Center. **Joe Revelle** and **Angie Pelkie** from Optech and **Harold Orlinsky** from Hypack assisted the scientists.

To test the system, the team conducted a survey along Deer Island, a small barrier island immediately offshore of Biloxi. The island recently underwent restoration by the U.S. Army Corps of Engineers, and the test run can be used to develop baseline elevation data for this restoration effort. Once they were certain the system was operational, the team traveled to the remote Chandeleur Islands to survey a recently constructed oil-spill-mitigation sand berm. The initial intent of this 100-m-wide, 26-km-long manmade feature was to trap oil from the 2010 Deepwater Horizon oil spill. Since then, the berm has become of significant interest to coastal scientists and managers as a proxy for barrier-island response to storm impacts, and a useful site for observing and modeling the potential contributions of manmade structures to fragile barrier-island systems. The St. Petersburg Coastal and Marine Science Center has conducted extensive airborne lidar and bathymetric surveys around the sand berm over the past year; data from these surveys can be compared with data from July's integrated lidar-sonar mapping to assess the accuracy of the mapping.

The lidar and sonar systems provided high-resolution imaging of the subaerial and submerged extent of the islands. The experiment demonstrated that the systems can be integrated and rapidly deployed in shallow-water environments to obtain extremely accurate elevation measurements for modeling efforts and studies of coastal change over time. The collaboration and mutual enthusiasm of team members provided an enjoyable and educational field experience, and several research opportunities are being explored that can benefit from this integrated "topobathy" system. ☸



◄Seafloor depths (rainbow colors) acquired by swath and single-beam bathymetric survey conducted around the berm in June 2011, with oil-spill berm and Chandeleur Island shorelines (black and brown, respectively) acquired by lidar survey conducted in March 2011. Repeated surveys will be conducted to monitor seafloor response to short-term berm and island evolution. During construction, approximately 4 million m^3 of sediment was excavated from a borrow site 2 km north of the berm.

*Researchers developing the integrated boat-mounted lidar-sonar system (left to right): **Dustin Kimbrow** (USGS Alabama Water Science Center [AWSC]), **Joe Revelle** (Optech), **Kyle Kelso** (front; USGS St. Petersburg Coastal and Marine Science Center [SPCMSC]), **Angie Pelkie** (Optech), **Jim Flocks** (USGS SPCMSC), **Dana Wiese** (USGS SPCMSC), **Kathryn Lee** (USGS AWSC), **Harold Orlinsky** (Hypack), **BJ Reynolds** (USGS SPCMSC), and **Athena Clark** (USGS AWSC). The inline choke-ring GPS antenna, lidar system, and motion sensor are visible in background. Vessel used for deployment is a shallow-draft 8-m-long Glacier Bay catamaran.*

Final Beach-Erosion Survey of the Elwha River Delta Before Dam Removal

By Jonathan Warrick

On August 26-27, 2011, the U.S. Geological Survey (USGS) conducted its final beach-erosion survey of the Elwha River delta before a historic dam removal began upstream in September. The survey is part of an ongoing study of how damming has affected the ecosystem.

Two dams on the Elwha River—the Elwha and the Glines Canyon—have stopped most of the flow of sediment to the beaches on its delta for nearly 100 years. Historical photographs and topographic-survey data document severe erosion on these beaches, corroborated by 7 years of Global Positioning System (GPS) beach surveys conducted on foot and with personal watercraft by the USGS in collaboration with the Lower Elwha Klallam Tribe and the Washington State Department of Ecology.

Not only have the beaches eroded quickly during the past 100 years, but erosion rates have increased significantly over time. The greatest changes have been observed along the tribal reservation, where USGS scientists and their collaborators reported in a 2009 article that erosion averaged nearly 2 ft per year between 1939 and 2006 (see Warrick and others, *Geomorphology*, v. 111, no. 3-4, p. 136-148, **http://dx.doi.org/10.1016/j.geomorph.2009.04.012**). Most of the erosion has occurred along the primary pathway by which river sediment moves into and along the beach. The combination of the rapid beach erosion and the reduction of river sediment by the dams lends evidence that the dams are responsible for the beach erosion.

With erosion, other beach characteristics have also changed, and part of the USGS work is to study the changes' effects on wildlife habitat. For example, the lowest area of the beach east of the river mouth is mostly cobble, which is inconsistent with tribal oral histories suggesting that abundant shellfish were harvested from this beach. Erosion of the beach has apparently left behind only the largest and heaviest rocks.

The removal of the two dams on the Elwha River, which began September 17, 2011, will take about 2½ years to complete. As dam removal proceeds, new supplies of sediment will flow downriver to the beaches of the river delta. Although only part of the approximately 20 million m^3 of sediment now trapped behind the dams will move downstream, this sediment will likely slow—or even reverse—the recent trends of erosion on the beach.

The USGS plans to continue these surveys for several years after the dam removal to evaluate how a beach responds to restoration of its sediment supply. Such studies are important to evaluate the effectiveness of this and future coastal-restoration efforts.

The Elwha River Restoration Project, created by act of Congress in 1992, aims at the full restoration of the Elwha River ecosystem and the native fish that ascend the river from the sea to breed. (To learn more, visit **http://usgs.gov/elwha/** and **http://www.nps.gov/olym/naturescience/elwha-ecosystem-restoration.htm**; see also *Elwha River Dam Removal—Rebirth of a River*, USGS Fact Sheet 2011-3097, **http://pubs.usgs.gov/fs/2011/3097/**.)

*Locations of Elwha and Glines Canyon Dams on the Elwha River in northern Washington. From USGS Fact Sheet 2011-3097 (**http://pubs.usgs.gov/fs/2011/3097/**).*

***Heather Baron**, Oregon State University, uses a personal watercraft to map seafloor depths in the Elwha River mouth. Mounted on the stern are a Global Positioning System (GPS) antenna on the right and a radio antenna on the left to receive differential corrections for the GPS. The black case between them contains a computer, GPS receiver, and single-beam echosounder. The screen mounted near the bow displays navigational information. Photograph by **Andrew Stevens**, USGS.*

***Andrew Schwartz**, Washington State Department of Ecology, holds a data collector that logs his position (latitude, longitude, and elevation) as he maps the beach along preplanned transects from just landward of the primary dune crest to the waterline. His backpack holds a GPS receiver and antenna. Photograph by **Andrew Stevens**, USGS.*

Aerial Photographs of Outer Banks Show Coastal Damage from Hurricane Irene

By Matthew Cimitile, Abby Sallenger, Hilary Stockdon, Karen Morgan, and Dennis Krohn

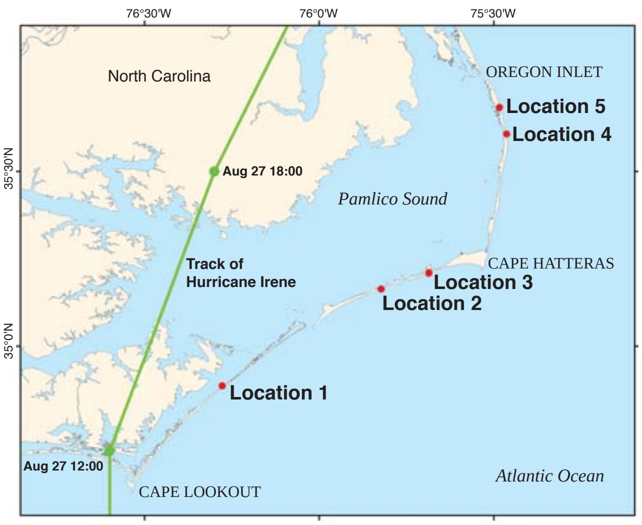
A series of before-and-after aerial photographs of North Carolina's Outer Banks shows the impact of Hurricane Irene on the coastline, highlighting several breaches that severed a state highway and moved large volumes of sand inland.

The series, produced by the U.S. Geological Survey (USGS) and posted online at **http://coastal.er.usgs.gov/hurricanes/irene/photo-comparisons/**, features five photo pairs that show coastal change in areas from Cape Lookout to Oregon Inlet.

Hurricane Irene made direct landfall near Cape Lookout on August 27, 2011. Because of the right-angle shape of the Outer Banks, barrier islands facing southeast underwent different coastal changes than those facing east.

The southeast-facing coast, from Cape Lookout to Cape Hatteras, was exposed to waves and surge from the ocean. Photographs of Ocracoke Island (location 2 on map) show large volumes of sand removed from the beach system and deposited over roads and grass marshes. Flooding by storm surge in these areas was minimal, however, as surge crested above dunes only in limited places.

The east-facing coast, from Cape Hatteras to Oregon Inlet, also was exposed to waves and surge from the ocean, but surge was higher in the sound. Sections of Rodanthe (location 4 on map) and Pea Island National Wildlife Refuge (location 5) were exposed to storm surge from Pamlico Sound of about 6 ft, which contributed to carving of channels through the island that breached a state highway in several places. A total of five breaches were cut through the coastal landscape between Cape Hatteras and Oregon Inlet.



North Carolina's Outer Banks, showing track of Hurricane Irene and site (location 4) where photographs accompanying this article were taken.

"Such multiple breaches, or new inlets, cut through the Outer Banks could take weeks to months to close on their own," said USGS oceanographer **Asbury (Abby) Sallenger**, "and without intervention like pumping sand, some could even persist indefinitely, depending on the channel's cross section and the volume of water flushed through it on every tide."

Oblique aerial photographs of Rodanthe, North Carolina, from May 6, 2008 (top, pre-storm), and August 31, 2011 (bottom, post-storm). The yellow arrow in each image points to the same cottage. A breach was carved through the barrier island, severing North Carolina Highway 12. The storm surge was approximately 2 m high on the soundside and less on the oceanside. Flow from the sound to the ocean may have played a role in cutting the breaches between Oregon Inlet and Cape Hatteras.

Three days after the landfall of Hurricane Irene, USGS scientists acquired detailed information about coastal change through aerial photography and an airborne lidar (light detection and ranging) survey conducted with the National Oceanic and Atmospheric Administration. Airborne lidar is a remote-sensing tool attached to an aircraft that uses laser pulses to collect highly detailed ground-elevation data. Information from the surveys allows scientists to discern the degree of changes to beaches and coastal environments and to determine how much the land has eroded and where new inlets have cut through. The photographic and lidar information will be useful in mitigation and restoration efforts, such as rebuilding North Carolina Highway 12, which was severed in several places by breaches cut through the barrier islands by Hurricane Irene.

Data acquired will also be used to make more accurate predictive models of future coastal impacts from severe storms and to identify areas vulnerable to extreme coastal change.

To view the before-and-after photographs illustrating coastal changes and damage from Hurricane Irene, visit **http://coastal.er.usgs.gov/hurricanes/irene/photo-comparisons/**. For information on hurricane preparedness, visit **http://www.ready.gov/**. ☸

Famous Manatee "Chessie" Sighted in Chesapeake Bay After Long Absence

By Cathy Beck, Rachel Pawlitz, and Jen Bloomer (National Aquarium)

A manatee spotted in mid-July in Calvert County, Maryland, is the same one that first made waves 17 years ago when he appeared in Chesapeake Bay just before the onset of winter and later had to be rescued.

The identity of the manatee, known as "Chessie," was verified by U.S. Geological Survey (USGS) biologist **Cathy Beck**, who matched photographs taken July 12 with Chessie's photographic record in a USGS manatee database. Chessie's telltale markings include a long, gray scar on his left side.

Chessie surfaces for a breath in Chesapeake Bay in Calvert County, Maryland, on July 12, 2011. Photograph courtesy of ***Hank Curtis.***

USGS scientists regularly document manatee sightings to analyze the life histories of individuals as part of an ongoing effort to estimate adult survival rates of the endangered Florida manatee. Yet biologists were surprised to find that the animal sighted in July was Chessie, a well-known manatee who had not been seen for about 10 years. The last time USGS researchers confirmed a sighting of Chessie was after he swam through Great Bridge Locks in Virginia on August 30, 2001 (details at **http://fl.biology.usgs.gov/Manatees/Manatee_Sirenia_Project/Manatee_Chessie_Surfaces/manatee_chessie_surfaces.html**).

By then, Chessie was already well known. After Chessie was found in the Kent Narrows area of the Chesapeake Bay in the fall of 1994, researchers became concerned about how he would fare during the oncoming winter. Manatees suffer negative health effects when they endure water temperatures below 68°F for any length of time. With water temperatures dropping in the bay, the Marine Animal Rescue Program at the National Aquarium worked with the U.S. Fish and Wildlife Service, Seaworld Orlando, and the Maryland Department of Natural Resources to rescue Chessie. He was cared for at the aquarium for several days before being successfully flown back to Florida and released.

The summer sighting did not drive any plans to rescue Chessie because the water was still warm and manatees typically work their way back down the eastern seaboard to Florida on their own when cooler weather sets in.

Scientists are not sure whether Chessie visits the Chesapeake Bay every year. After Chessie's 1994 rescue, USGS scientists tagged him and found that he did migrate back to Chesapeake Bay the following spring. (That tag and a second radio transmitter fell off; Chessie is not currently tagged.) Much of what scientists know about manatee migration comes from studies that use radio and satellite tags to reveal key facts about manatees' habitat needs, such as how they use seagrasses and winter refuges.

In general, scientists believe manatee migration from Florida to the Chesapeake Bay may not be unusual, and, in fact, Chessie was named after legendary sightings of a "sea monster" in the Chesapeake Bay throughout the 20th century.

Chessie was spotted and identified this year thanks to the help of two bystanders who took pictures of him and contacted **Jennifer Dittmar**, the National Aquarium's Coordinator for the Northeast Marine Mammal Stranding Network. **Dittmar** forwarded **Beck** photographs of the manatee's head and back.

The public is urged to report all possible sightings of a manatee in Maryland waters to the National Aquarium's Stranding Hotline at 410-373-0083 and to send photographic images to **marp@aqua.org**.

Read more about Chessie and how manatees are identified in "Manatee Traveler in Northeastern Waters Not Chessie," *Sound Waves*, September 2006 (**http://soundwaves.usgs.gov/2006/09/research2.html**). A history of Chessie sightings is posted at **http://fl.biology.usgs.gov/Manatees/Manatee_Sirenia_Project/Manatee_Chessie_Surfaces/manatee_chessie_surfaces.html**. For additional information about manatee biology, visit the USGS Sirenia Project's Web site at **http://fl.biology.usgs.gov/Manatees/manatees.html**. ☸

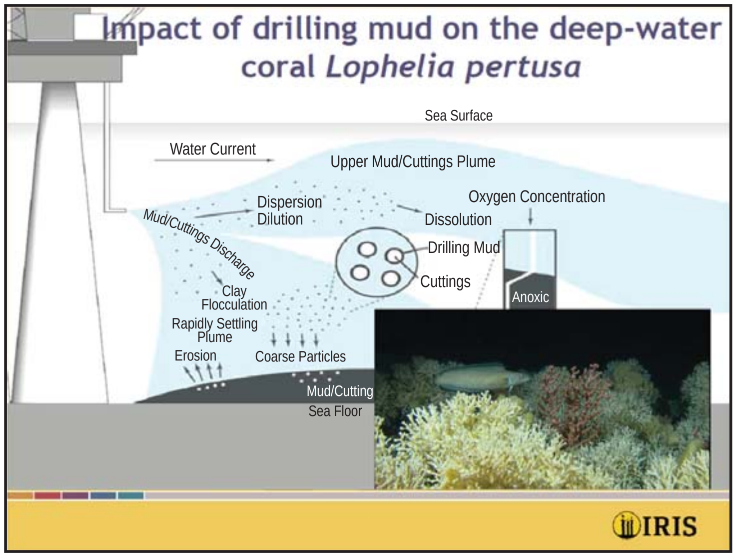
Photograph of Chessie taken in 2001 shows a distinctive scar on his left side used to identify him.

International Team Studies Impacts of Oil and Gas Drilling on Cold-Water Corals in Norway

By Christina Kellogg

Oil and gas exploration in the North Sea, as in the Gulf of Mexico, involves deep-sea drilling. Commonly, areas of interest for hydrocarbons overlap areas where cold-water corals (also called deep-sea corals) live. These corals do not have photosynthetic algal symbionts (zooxanthellae) like tropical corals, but they do create complex habitat for hundreds of other animals, including fishes, crabs, and shrimp. These cold-water coral reefs are centers of biodiversity in deep water. Regulations exist to keep drilling from occurring too close to the corals; however, drilling mud (a slurry of clays used to keep the drill lubricated) can form long plumes of particulates that may affect corals some distance from the drilling operation.

In June 2011, U.S. Geological Survey (USGS) scientist **Christina Kellogg** traveled to Norway to join an international team conducting research on the impacts of drilling mud on the cold-water coral *Lophelia pertusa*. Coordinated by the International Research Institute of Stavanger (IRIS) and funded by the Research Council of Norway, this project seeks to develop diagnostic tools to monitor nonlethal stress in these corals. **Kellogg** has worked on the microbial ecology of *Lophelia* in the Gulf of Mexico since 2004 and will lend her expertise to investigating microbial indicators of coral stress. Additionally, the team will conduct experiments that attempt to link diagnostic changes (such as shifts in the microbial community or changes in biomarkers in coral mucus) to specific effects on the coral (such as impairment in reproduction and growth). Data from controlled experiments conducted on corals maintained in aquaria will ultimately be incorporated into a physiological computer model that can be used to predict impacts. The ultimate goal is to determine what impacts drilling mud has on this cold-water coral and, on the basis of that information, to establish criteria for environmental-risk assessment in order to ensure that no harm comes to these deep-sea habitats.



Schematic shows how drilling-mud discharge affects areas both near and far from the drilling platform. Inset photograph shows lush cold-water coral habitat with lots of Lophelia *(white branching mounds) as well as other corals and sponges. Schematic courtesy of the International Research Institute of Stavanger (IRIS); photograph by Pål Mortensen, Institute of Marine Research, Bergen, Norway.*

Closeup of a piece of Lophelia *being maintained in an aquarium, showing the coral's extended tentacles, which it uses to capture food.*

*Project Chief **Thierry Baussant** (far left; IRIS) with visiting researchers (left to right) **Dick van Oevelen** (Netherlands Institute of Ecology), **Sandra Brooke** (Marine Conservation Institute), **Johanna Jarnegren** (Norwegian Institute for Natural Research), and **Christina Kellogg** (USGS).*

Significant Natural Gas Resources Remain to Be Discovered in Cook Inlet, Alaska

By Brenda Pierce and Richard G. Stanley

The U.S. Geological Survey (USGS) recently completed a new assessment of undiscovered, technically recoverable oil and gas resources in the Cook Inlet region of south-central Alaska. Using a geology-based assessment methodology, the USGS estimates that mean undiscovered volumes of nearly 600 million barrels of oil, about 19 trillion ft^3 of natural gas, and 46 million barrels of natural-gas liquids remain to be found in this area. The estimates were announced on June 28, 2011.

The gas estimates are significantly more than the last USGS assessment of southern Alaska in 1995, in which a mean of 2.16 trillion ft^3 of gas was estimated. This increase in the undiscovered resource is attributed to new geologic information and data and the inclusion of unconventional (or continuous) resources in the 2011 assessment.

“For the first time, USGS has evaluated unconventional as well as conventional petroleum resources in the Cook Inlet region of Alaska,” said **Brenda Pierce**, USGS Energy Resources Program Coordinator. “The USGS conducts assessments to evaluate the nation’s petroleum potential, especially as new data and information become available, in order to understand the resource endowment of the nation.”

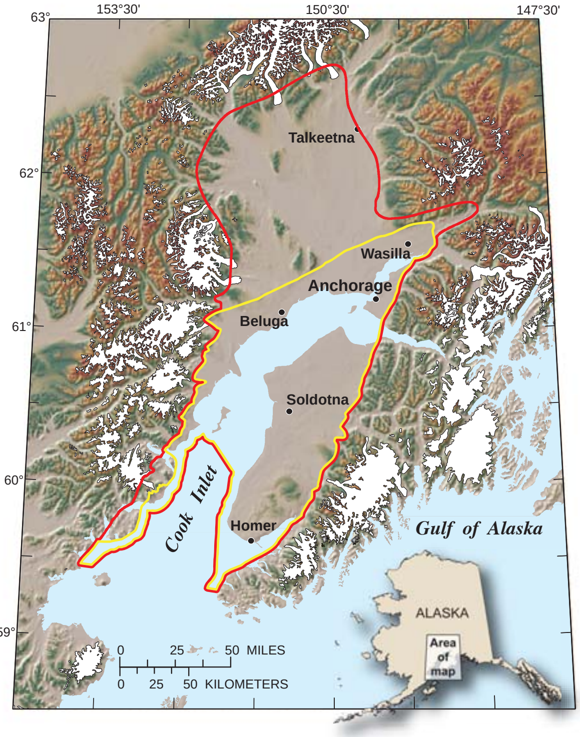
The USGS assessment is intended to provide an updated, scientifically based estimate of petroleum potential at a time of increased public concern about possible shortages of natural-gas supplies in Anchorage and nearby communities, where natural gas (methane) produced from the Cook Inlet region is the principal source of energy for heating and electric-power generation.

Since oil and gas production began in the Cook Inlet region in 1958, more than 1.3 billion barrels of oil and 7.8 trillion ft^3 of gas have been produced, yet the new USGS assessment shows that significant undiscovered gas remains.

This USGS assessment includes estimates of conventional and unconventional, or continuous, accumulations, including coalbed gas and tight gas formations. Coalbed gas is a form of natural gas extracted from coal seams, whereas tight gas is natural gas occurring in compact rock formations with very low permeability. Both types of gas require different production techniques than conventional gas accumulations.

These new estimates are for undiscovered, technically recoverable oil and gas resources, which are those quantities of oil and gas producible by using currently available technology and industry practices, regardless of economic or accessibility

(Cook Inlet Gas continued on page 11)



*A USGS assessment released in June 2011 indicates that significant natural-gas resources remain to be discovered in Cook Inlet. Yellow outline shows area evaluated for conventional oil and gas and tight gas; red outline shows area evaluated for coalbed gas. Modified from USGS Fact Sheet 2011-3068 (**http://pubs.usgs.gov/fs/2011/3068/**).*

*Offshore oil-production platform in Cook Inlet. Photograph by **Rick Stanley**.*

(Cook Inlet Gas continued from page 10)

considerations. As such, these estimates include resources beneath both onshore and offshore areas of the Cook Inlet region (exclusive of the federal offshore) and beneath areas where accessibility may be limited by policy and regulations imposed by land managers and regulatory agencies.

The USGS worked with the Alaska Division of Geological and Geophysical Surveys and the Alaska Division of Oil and Gas to develop a geologic understanding of the Cook Inlet region. The USGS Cook Inlet assessment was undertaken as part of a nationwide project assessing domestic petroleum basins using standardized methodologies and protocols.

A Fact Sheet describing the results of the USGS Cook Inlet assessment is posted at **http://pubs.usgs.gov/fs/2011/3068/**. To learn more about this or other geologic assessments, visit the Energy Resources Program's Web site at **http://energy.usgs.gov/**. ☸

Marwan Wartes *of the Alaska Division of Geological and Geophysical Surveys on an outcrop of cross-laminated sandstone in the Beluga Formation west of Homer, Alaska. Where this formation occurs deep underground, it serves as a reservoir rock for natural gas. Photograph by* ***Rick Stanley****.*

Staff and Center News

Summer Interns Help Organize USGS Library and Map Collections in St. Petersburg, Florida

By Ellen Raabe and Lindsay Bartz

Lindsay Bartz and **Sandra Ionescu** assisted this summer at the U.S. Geological Survey (USGS) St. Petersburg Coastal and Marine Science Center in St. Petersburg, Florida. **Bartz** and **Ionescu** made substantial progress in organizing, cataloging, and archiving library, map, and outreach resources. Their efforts will make reference materials more readily available to scientists and office outreach staff. Office sponsors, **Ellen Raabe**, Physical Scientist, and **Theresa Burress**, Librarian, appreciate the volume of work accomplished. The summer interns also participated in lunchtime yoga, as interviewees for the Oceanography Camp for Girls, and in other outreach activities.

Lindsay Bartz

Ionescu is an undergraduate biology major at the University of Florida; she plans on earning a Ph.D. and conducting research in botany or genetics in a university setting.

Bartz is a senior at Virginia Tech and will graduate with a degree in geology; she hopes to continue with graduate studies after gaining real-world experience with technologies available to geoscientists. Eventually, **Bartz** hopes to work in a research-based institute studying plate tectonics. She will apply her observations of standard map resources to a geographic-information-system (GIS) course this fall. ☸

Sandra Ionescu

New Interns Join USGS Southeast Ecological Science Center Staff at Everglades National Park

By Thomas J. Smith III

*Interns **Leigh Gordon-Patti** (left) and **Tim Krawczyk** at the Daniel Beard Center, the base for most of the fieldwork done in Everglades National Park.*

Tim Krawczyk has become an intern with the U.S. Geological Survey (USGS), joining USGS Southeast Ecological Science Center (SESC) staffers **Gordon Anderson** and **Karen Balentine** at the Daniel Beard Center in Everglades National Park, Florida. **Krawczyk** is currently working toward a B.S. in geosciences at the Christian-Albrechts University in Kiel, Germany, where he specializes in marine geology and hydrogeology. He is working in the park under the auspices of the National Park Service's International Volunteers in Parks (IVIP) Program (**http://www.nps.gov/oia/topics/ivip/ivip.htm**). **Krawczyk** is conducting a project dealing with sediment dynamics in the mangrove forests of the coastal Everglades, with a particular focus on resuspension and movement of sediment.

Leigh Gordon-Patti has also started an internship with the USGS. A native of Miami, Florida, she is studying journalism, sociology, and environmental policy at Northwestern University in Evanston, Illinois. While in the Everglades, **Gordon-Patti** is conducting field research to record soil hydrology and vegetation change in coastal mangroves with SESC scientist **Tom Smith**. She is also working with **Rachel Pawlitz**, SESC outreach coordinator, to develop her observations of the relationship between USGS science and Everglades National Park management into an outreach product.

Tim can be reached at **tim.krawczyk@gmx.de** and **Leigh** at **leighgordonpatti2014@u.northwestern.edu**. ❆

Publications

Publications Explain Elwha River Restoration to Scientists, General Public

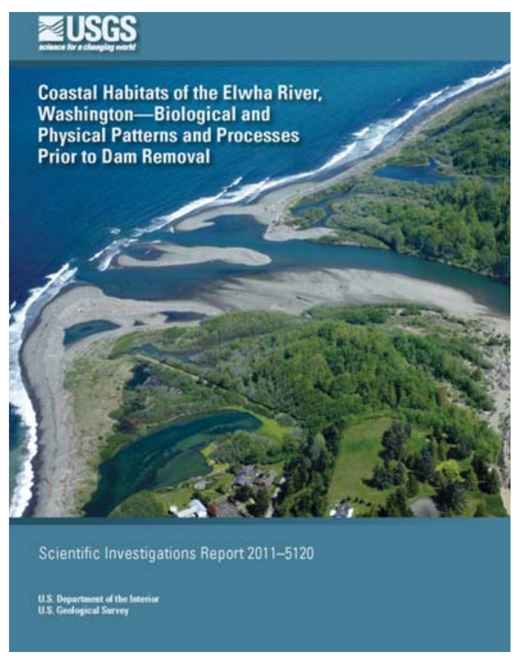
By Barbara Wilcox

Two new U.S. Geological Survey (USGS) publications explain to scientists and the general public what to expect as the historic removal of two dams from Washington's Elwha River begins what is hoped to be a full ecosystem restoration. A staged process expected to take 2 to 3 years, dam removal began in mid-September.

Elwha River Dam Removal—Rebirth of a River (USGS Fact Sheet 2011-3097, **http://pubs.usgs.gov/fs/2011/3097/**) is a four-page, full-color brochure meant for the general public that explains both why the federal government is removing the dams, which have disrupted natural processes for nearly a century, and also why long-term scientific study of the area is important as the restoration's ecological consequences unfold. With maps, charts, and photographs, the brochure explains how the dams' removal will affect fisheries, vegetation, and the coastal terrain.

Simultaneously, the USGS has released *Coastal Habitats of the Elwha River, Washington—Biological and Physical Patterns and Processes Prior to Dam Removal* (USGS Scientific Investigations Report 5120, **http://pubs.usgs.gov/sir/2011/5120/**), which

(Elwha Publications continued on page 13)



*Cover of the new Scientific Investigations Report shows the Elwha River entering the Strait of Juan de Fuca and the estuary of interconnected water bodies east and west of the river. Photograph taken by **John Gussman**, Doubleclick Productions, Sequim, Washington, April 22, 2010.*

(Elwha Publications continued from page 12)

presents the results of 6 years of multidisciplinary studies characterizing the lower Elwha River, its estuary, and coastal habitats in anticipation of dam removal. This nine-chapter report from a multiagency team of biologists, ecologists, hydrologists, river geomorphologists, and coastal geologists offers the most current understanding of Elwha coastal habitats and their predicted changes after dam removal.

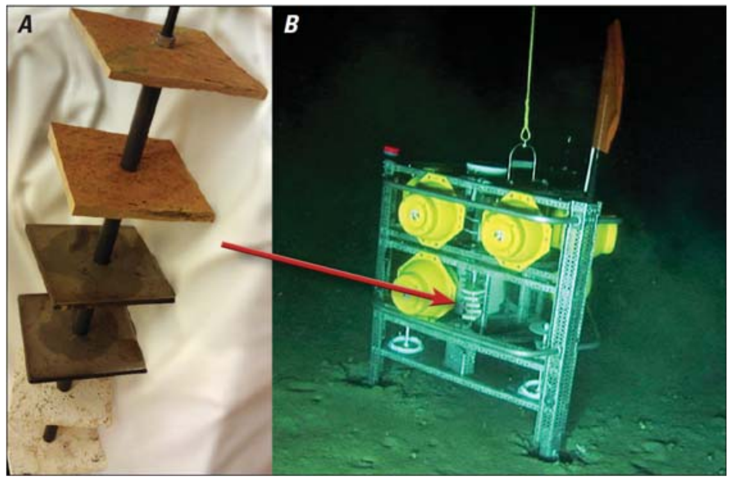
Much of the work in the Scientific Investigations Report was presented September 15-16, 2011, at a 2-day Elwha River Science Symposium at Peninsula College in Port Angeles, Washington, preceding the "Celebrate Elwha" event (**http://celebrateelwha.com/**) that marked the beginning of the dams' removal.

The Elwha River Restoration Project, created by act of Congress in 1992, aims at the full restoration of the Elwha River ecosystem and the native fish that ascend the river from the sea to breed. (For more information, visit **http://usgs.gov/elwha/**.)

Microbial Ecology of Deep-Water Mid-Atlantic Canyons

By Christina Kellogg

A new U.S. Geological Survey (USGS) Fact Sheet highlights microbiological experiments that will be conducted in submarine canyons along the U.S. east coast. This work is part of the USGS DISCOVRE (Diversity, Systematics, and Connectivity of Vulnerable Reef Ecosystems) Project (**http://fl.biology.usgs.gov/DISCOVRE/**), an integrated, multidisciplinary effort investigating deep-sea communities from the microscopic to the ecosystem level. DISCOVRE is the USGS-funded component of a much larger research effort focused on the deep-water canyons off of the U.S. mid-Atlantic coast that involves the National Oceanic and Atmospheric Administration (NOAA), the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), and numerous academic researchers. (See related article "High-Resolution Multibeam Mapping of Mid-Atlantic Canyons to Assess Tsunami Hazards," this issue, **http://soundwaves.usgs.gov/2011/10/**.)



Experiments will be conducted by using settling plates to determine which types of microbial biofilms form on different surfaces. A, Closeup of a stack of settling plates, featuring 4-in. by 4-in. by ¼-in. limestone, steel, and sandstone settling plates; B, Stack of settling plates (arrow) deployed in deep water on a benthic lander. Photograph B courtesy of ***Steve Ross****, University of North Carolina Wilmington, and* ***Sandra Brooke****, Marine Conservation Institute. USGS Fact Sheet 2011-3102, figure 3.*

During a series of research cruises in 2012-14, samples will be collected and experiments deployed in the canyons along the mid-Atlantic bight (a coastal region running from Massachusetts to North Carolina). Characterized by swift currents and steep walls that extend miles deep, these canyons are unique ecosystems that have rarely been studied. Rocky outcrops in the canyons provide important habitat for deep-sea corals, which require hard surfaces to grow on. This study will identify and characterize the beneficial microbes associated with these corals, as well as the microbial biofilms that initially colonize hard surfaces in the canyons to prepare them for settlement by larger invertebrates, such as corals and sponges. Additionally, the microbial communities in the soft sediment on the floors of the canyons will be counted and classified to incorporate them into food web and benthic ecology studies.

The new Fact Sheet is posted at **http://pubs.usgs.gov/fs/2011/3102/**.

Recently Published Articles

Dartnell, P., and Gibbons, H., 2011, Floor of Lake Tahoe, California and Nevada: U.S. Geological Survey General Information Product 132, postcard [**http://pubs.usgs.gov/gip/132/**].

Dreher, C.A., and Flocks, J.G., Methods for processing and imaging marsh foraminifera: U.S. Geological Survey Fact Sheet 2011-3098, 4 p. [**http://pubs.usgs.gov/fs/2011/3098/**].

Duda, J.J., Warrick, J.A., and Magirl, C.S., 2011, Elwha River dam removal—rebirth of a river: U.S. Geological Survey Fact Sheet 2011-3097, 4 p. [**http://pubs.usgs.gov/fs/2011/3097/**].

Duda, J.J., Warrick, J.A., and Magirl, C.S., eds., 2011, Coastal habitats of the Elwha River, Washington—biological and physical patterns and processes prior to dam removal: U.S. Geological Survey Scientific Investigations Report 2011–5120, 264 p. [**http://pubs.usgs.gov/sir/2011/5120/**].

Field, M.E., Ogston, A.S., and Storlazzi, C.D., 2011, Rising sea level may cause decline of fringing coral reefs: Eos (American Geophysical Union

(Recently Published continued on page 14)

(Recently Published continued from page 13)

Transactions), v. 92, no. 33, p. 273-274, doi:10.1029/2011/EO330001 [**http://dx.doi.org/10.1029/2011EO330001**].

Finlayson, D.P., Miller, I.M., and Warrick, J.A., 2011, Bathymetry and acoustic backscatter—Elwha River delta, Washington: U.S. Geological Survey Open-File Report 2011-1226 [**http://pubs.usgs.gov/of/2011/1226/**].

Kellogg, C.A., 2011, Microbial ecology of deep-water mid-Atlantic canyons: U.S. Geological Survey Fact Sheet 2011–3102, 2 p. [**http://pubs.usgs.gov/fs/2011/3102/**].

Lacy, J.R., and Hoover, D.J., 2011, Wave exposure of Corte Madera Marsh, Marin County, California; a field investigation: U.S. Geological Survey Open-File Report 2011-1183, 28 p. [**http://pubs.usgs.gov/of/2011/1183/**].

Nielsen, S.G., Gannoun, A., Marnham, C., Burton, K.W., Halliday, A.N., and Hein, J.R., 2011, New age for ferromanganese crust 109D-C and implications for isotopic records of lead, neodymium, hafnium, and thallium in the Pliocene Indian Ocean: Paleoceanography, v. 26, PA2213, 13 p., doi:10.1029/2010PA002003 [**http://dx.doi.org/10.1029/2010PA002003**].

Stanley, R.G., Charpentier, R.R., Cook, T.A., Houseknecht, D.W., Klett, T.R., Lewis, K.A., Lillis, P.G., Nelson, P.H., Phillips, J.D., Pollastro, R.M., Potter, C.J., Rouse, W.A., Saltus, R.W., Schenk, C.J., Shah, A.K., and Valin, Z.C., 2011, Assessment of undiscovered oil and gas resources of the Cook Inlet region, south-central Alaska, 2011: U.S. Geological Survey Fact Sheet 2011-3068, 2 p. [**http://pubs.usgs.gov/fs/2011/3068/**].

Stock, J.D., Cochran, S.A., Field, M.E., Jacobi, J.D., and Tribble, G., 2011, From ridge to reef—linking erosion and changing watersheds to impacts on the coral reef ecosystems of Hawai'i and the Pacific Ocean: U.S. Geological Survey Fact Sheet 2011-3049 [**http://pubs.usgs.gov/fs/2011/3049/**].

Wasylenki, L.E., Weeks, C.L., Bargar, J.R., Spiro, T.G., Hein, J.R., and Anbar, A.D., 2011, The molecular mechanism of Mo isotope fractionation during adsorption to birnessite: Geochimica et Cosmochimica Acta, v. 75, no. 17, p. 5019-5031, doi:10.1016/j.gca.2011.06.020 [**http:dx.doi.org/10.1016/j.gca.2011.06.020**].

Publications Submitted for Bureau Approval

Barnard, P.L., Hubbard, D.M., and Dugan, J., Understanding regional beach evolution patterns on an alongshore-dominated littoral cell based on 17 years of single-point sand thickness measurements [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 5-9, 2011.

Barth, G.A., Gulick, S.P.S., Reece, R.S., Childs, J.R., LeVoir, M.A., Hart, P.E., Sliter, R.W., Lester, W.R., Johnson, K.M., and Everson, E.D., Basement control of sediment routing in the Gulf of Alaska [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 5-9, 2011.

Beeson, J.W., Goldfinger, C., Johnson, S.Y., Wakefield, W.W., and Clarke, M.E., Geophysical investigation of the offshore portion of the northern segment of the San Andreas fault on a "green research vessel" [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 5-9, 2011.

Buckley, S., Lacy, J.R., and McPhee-Shaw, E., The effect of wave variability on bedform dimensions [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 5-9, 2011.

Comer, N.N., and Lisle, J.T., Characterization of coastal sediments from the Gulf of Mexico and Atlantic shorelines, Texas to Florida; a preliminary report to the U.S. Coast Guard: U.S. Geological Survey Open-File Report 2011-1151.

Cross, V.A., Bratton, J.F., Worley, C.R., Crusius, J., and Kroeger, K.D., Continuous resistivity profiling data from the Corsica River estuary, Maryland: U.S. Geological Survey Open-File Report 2010-1094.

DeWitt, N.T., Flocks, J.G., Pendleton, E.A., Hansen, M.E., Reynolds, B.J., Kelso, K.W., Wiese, D.S., Worley, C.R., and Sanford, J., Archive of single beam and swath bathymetry data collected nearshore of the Gulf Islands National Seashore, Mississippi, from West Ship Island, Mississippi, to Dauphin Island, Alabama; methods and data report for USGS cruises 08CCT01, 08CCT02 (July 2008) and 09CCT03, 09CCT04 (June 2009): U.S. Geological Survey Data Series.

Dimova, N.T., Swarzenski, P.W., and Dulaiova, H., Utilizing multichannel electrical resistivity methods to examine the dynamics of the fresh water-seawater interface in two Hawaiian groundwater systems: Journal of Geophysical Research.

Edwards, B.D., Saint-Ange, F., Pohlman, J.W., Higgins, J., Mosher, D.C., Lorenson, T.D., and Hart, P.E., Sedimentology of cores recovered from the Canada Basin of the Arctic Ocean [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 5-9, 2011.

Erikson, L.H., Richmond, B.M., Gibbs, A.E., and Jones, B., Observations of permafrost bluff failure processes, Barter Island, NE Alaska [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 5-9, 2011.

Field, M.E., Storlazzi, C.D., Gibbs, A.E., Cochran, S.A., and Logan, J.B., Regime shifts on Hawaiian coral reefs; from coral to sediment plains [abs.]: International Coral Reef Symposium, 12th, Cairns, Queensland, Australia, July 9-13, 2012.

Flocks, J., Miselis, J., Plant, N., and Sallenger, A., The northern Chandeleur Islands and the emergency oil-spill mitigation sand berm; a proxy for shoreline response to large-scale revitalization projects? [abs.]: Basics of the Basin Symposium, 10th Biennial, Hammond, La., October 27-29, 2011.

Fredericks, X., Nayegandhi, A., Bonisteel-Cormier, J.M., Wright, C.W., Sallenger, A.H., Brock, J.C., Klipp, E.S., and Nagle, D.B., EAARL coastal topography—eastern Florida, post-Hurricane Jeanne, 2004; bare Earth: U.S. Geological Survey Data Series.

Galkiewicz, J., Vega Thurber, R., and Kellogg, C.A., Metagenomic analysis

(Publications Submitted continued on page 15)

(Publications Submitted continued from page 14)

of the microbial community associated with *Lophelia pertusa*, a cold-water coral [abs.]: American Society for Microbiology, Florida Branch Annual Meeting, Islamorada, Fla., September 24-25, 2011.

Gray, M.A., and Kellogg, C.A., Field deployable methods for bacterial community DNA preservation [abs.]: American Society for Microbiology, Florida Branch Annual Meeting, Islamorada, Fla., September 24-25, 2011.

Hansen, J.E., List, J.H., Elias, E., Erikson, L.H., and Barnard, P.L., Alongshore circulation driven by waves and tides at an inlet adjacent energetic shoreline: Journal of Geophysical Research.

Hein, J.R., Conrad, T.A., and Koschinsky, A., Marine ferromanganese deposits as a source of rare metals for high- and green-tech applications; comparison with land-based deposits [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 5-9, 2011.

Hein, J.R., de Ronde, C.E.J., Koski, R.A., Leybourne, M., Conrad, T.A., Ditchburn, R., Tamura, Y., Stern, R.J., and Ishizuka, O., Gold-silver-zinc-lead-rich barite mound field, E. Diamante Caldera, Mariana volcanic arc [abs.]: Goldschmidt Conference, Prague, Czech Republic, August 14-19, 2011.

Jaffe, B.E., Assessing tsunami hazard from the geologic record [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 5-9, 2011.

Jaffe, B.E., Foxgrover, A., and Finlayson, D.P., Mudflat loss during South San Francisco Bay salt pond restoration—the 800-pound sea level rise gorilla [abs.]: State of the San Francisco Estuary Conference, 10th Biennial, Oakland, Calif., September 20-21, 2011.

Jaffe, B.E., Peters, R., and Richmond, B., The sedimentary signature of recent tsunamis [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 5-9, 2011.

Johnson, S.Y., Ritchie, A.C., Conrad, J.E., Dartnell, P., Phillips, E.L., and Sliter, R.W., Post-Last Glacial Maximum (latest Pleistocene to Holocene) geology of the Santa Barbara shelf, southern California [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 5-9, 2011.

Kleppe, J.A., Brothers, D.A., Kent, G.M., Biondi, F., Jensen, S., and Driscoll, N.W., Duration and severity of Medieval drought in the Lake Tahoe Basin: Quaternary Science Reviews.

Lorenson, T.D., Collett, T.S., and Schoderbek, D., Geochemical evidence for gas hydrate occurrences in the ConocoPhillips gas hydrate production test well, North Slope, Alaska [abs.]: American Association of Petroleum Geologists Annual Convention, Long Beach, Calif., April 22-25, 2012.

Lorenson, T.D., Collett, T.S., and Wong, F.L., A petroleum system model for gas hydrate deposits in northern Alaska: International Conference on Gas Hydrates, 7th, Edinburgh, Scotland, July 17-21, 2011, Proceedings.

Lorenson, T.D., Hart, P.E., Pohlman, J.W., and Edwards, B.D., Sources and implications of hydrocarbon gases from the deep Alaskan Beaufort Sea [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 5-9, 2011.

Lorenson, T.D., Leifer, I., Wong, F.L., Rosenbauer, R.J., Campbell, P.L., Lam, A., Hostettler, F.D., Greinert, J., Finlayson, D.P., and Luyendyk, B.P., Biomarker chemistry and acoustic imaging of natural petroleum seeps compared to produced oils offshore southern California: U.S. Geological Survey Scientific Investigations Report.

Nayegandhi, A., Bonisteel-Cormier, J.M., Wright, C.W., Brock, J.C., Nagle, D.B., Vivekanandan, S., Klipp, E.S., Fredericks, X., and Stevens, S., EAARL coastal topography—Assateague Island National Seashore, Maryland and Virginia, 2010: U.S. Geological Survey Data Series.

Ohman, K.A., Erikson, L.H., and Kinsman, N.E.M., Characterization of a storm surge exposed arctic inlet—Shaktoolik, Alaska [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 5-9, 2011.

Reed, D.L., Gibbons, H., and Edwards, B.D., Mapping the Arctic—Online undergraduate education using scientific research in international policy [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 5-9, 2011.

Richmond, B., Goto, K., Fujino, S., Nishimura, Y., Sugawara, D., Tappin, D.R., Witter, R., Jaffe, B., Chague-Goff, C., Szczucinski, W., Yulianto, E., and Goff, J., Field observations of erosion, deposition, and tsunami flow characteristics on the Sendai coastal plain after the March 2011, Tohoku-Oki tsunami, Japan [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 5-9, 2011.

Sallenger, A.H., Doran, K., and Howd, P., Hotspot of accelerated sea-level rise in U.S. Northeast from Greenland ice-sheet melt: Science.

Sallenger, A., Plant, N., Flocks, J., Long, J., Miselis, J., Sherwood, C., Hansen, M., Nayegandhi, A., and Wright, W., Deepwater Horizon oil-protection sand berm and its morphologic interactions with a natural barrier island; an overview [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 5-9, 2011.

Spear, J.W., Reynolds, C.E., and Poore, R.Z., Seasonal flux and assemblage composition of planktic foraminifera from the northern Gulf of Mexico; January 2008-2010: U.S. Geological Survey Open-File Report.

ten Brink, U., and Flores, C., Geometry and evolution of the Dead Sea basin from seismic tomography, gravity, and subsidence analysis: Journal of Geophysical Research.

Watt, J.T., Johnson, S.Y., and Langenheim, V.E., Fault intersections along the Hosgri fault zone, central California [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 5-9, 2011.

Weiss, R., and Jaffe, B., Quantitative sediment transport analysis of the 11 March 2011 Tohoku-Oki tsunami [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 5-9, 2011.

Xu, J.P., Paull, C., Barry, J., and Noble, M., Spatial and temporal scales of recent turbidity currents in Monterey Submarine Canyon, California [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 5-9, 2011.